Development of Indirect Cavernous Dural Arteriovenous Fistula after Trapping for Direct Carotid Cavernous Fistula

A Case Report

H. YOSHINO, H. ISHIHARA, F. OKA, S. KATO, M. SUZUKI

Department of Neurosurgery, Yamaguchi University School of Medicine; Yamaguchi, Japan

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Summary

A 60-year-old man with direct carotid cavernous fistula (CCF) due to a motor vehicle accident underwent internal carotid artery trapping following high-flow external carotid to internal carotid artery bypass (EC-IC bypass). Follow-up angiography revealed ipsilateral complex indirect cavernous arteriovenous fistula. Although the traumatic indirect CCF angioarchitecture differs from cavernous-sinus dural arteriovenous fistula (CS-DAVF), the present indirect fistula was similar to the latter. Complex indirect CCF can occur after treatment of direct CCF caused by severe head injury.

Introduction

Carotid-cavernous fistulas (CCFs) are classified according to etiology (spontaneous or traumatic) and anatomy (direct or indirect). Indirect CCFs are usually spontaneous, and mean CS-DAVF. The causes of CS-DAVF are unknown. Although trauma can cause indirect CCFs, their angioarchitecture is generally different from that of CS-DAVF [1]. This report describes a rare case of posttraumatic indirect CCF with similar angioarchitecture to CS-DAVF. In addition, we discuss the pathogenesis of CS-DAVF based on the findings in this rare case.

Case Report

A 60-year-old man was involved in a motor vehicle accident in April 2008. He was transported immediately by ambulance to a nearby hospital. He was found to be comatose on arrival at the emergency room. Computed tomography revealed diffuse traumatic subarachnoid hemorrhage, acute hydrocephalus, and bone fracture located in the medial part of the greater wing of the sphenoid (Figure 1A, B). The patient underwent ventricular drainage. His consciousness improved gradually, but he presented with severe proptosis, chemosis, conjunctival congestion, and orbital bruit on the right side. Right internal carotid angiography revealed a direct CCF (Figure 2A), and right external carotid angiography showed a small amount of extravasation at the right middle fossa (Figure 2B). Two weeks later, he was transferred to our hospital for treatment of direct CCF. The patient underwent trapping of the right internal carotid artery following high-flow external carotid to internal carotid artery bypass (EC-IC bypass). Chemosis of the conjunctiva, orbital congestion with proptosis, and orbital bruit were reduced after the operation. Ten days after the operation, right external carotid angiography revealed indirect CCF in the right side (Figure 3). The fistula was fed by numerous fine channels from the accessory meningeal artery and infraorbital artery, and

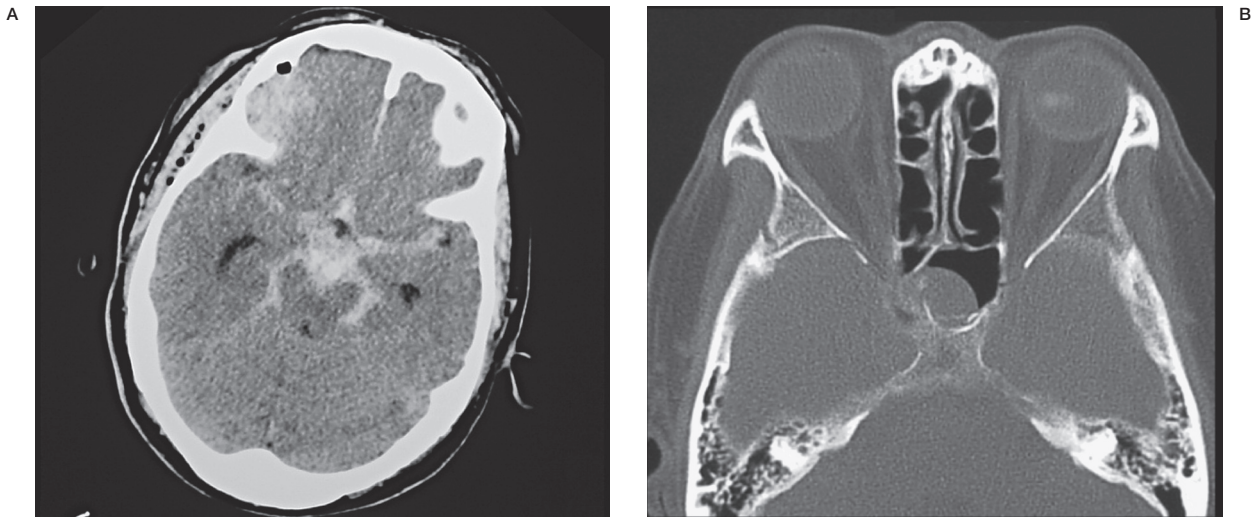

Figure 1 Computed tomography revealed diffuse subarachnoid hemorrhage (A) and bone fracture located in the medial part of the greater wing of the sphenoid (B).

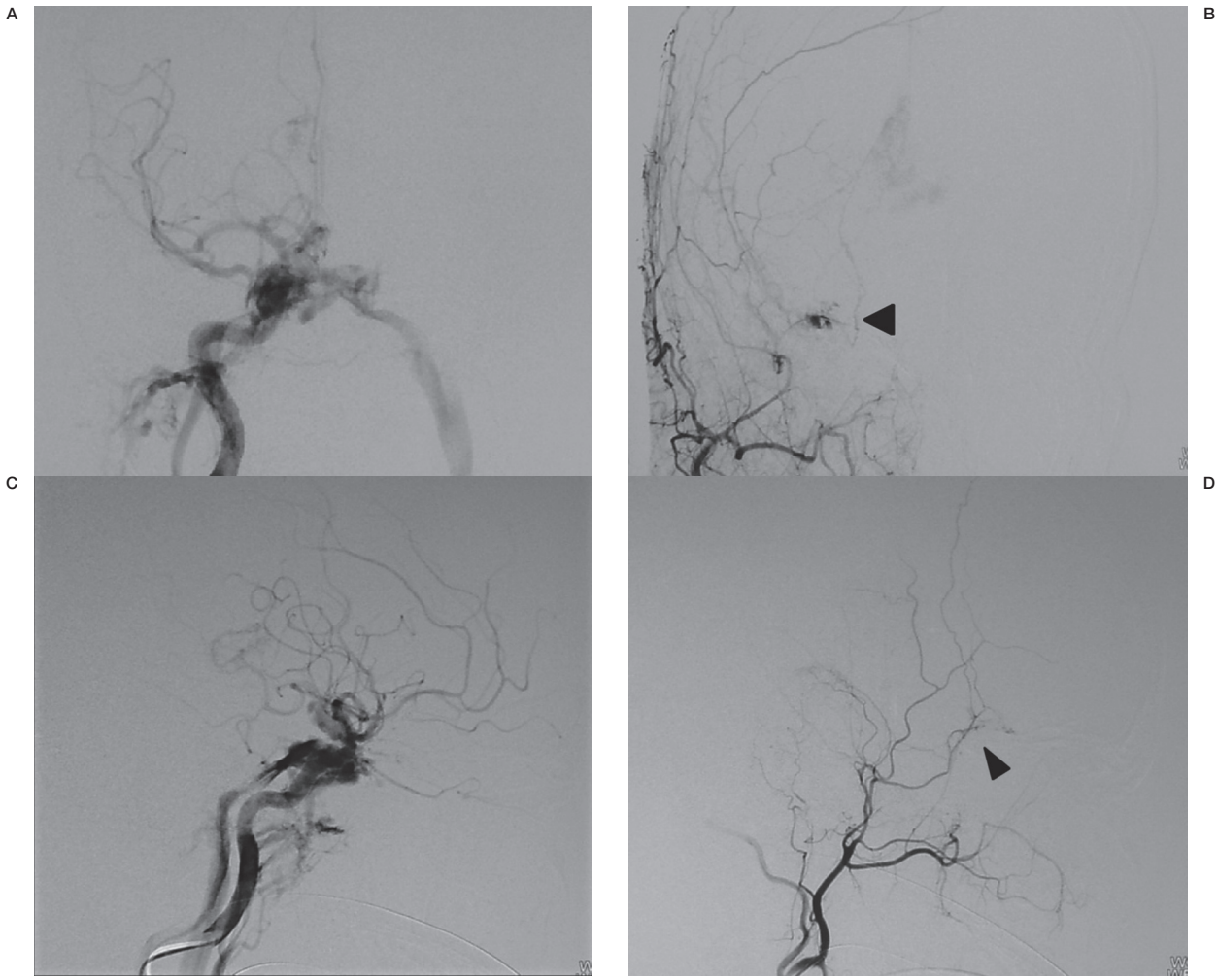

Figure 2 Right internal carotid angiogram (AP view) showed a direct carotid cavernous fistula (A). Right external carotid angiogram (AP view) revealed a small amount of extravasation at the right middle fossa (arrows).

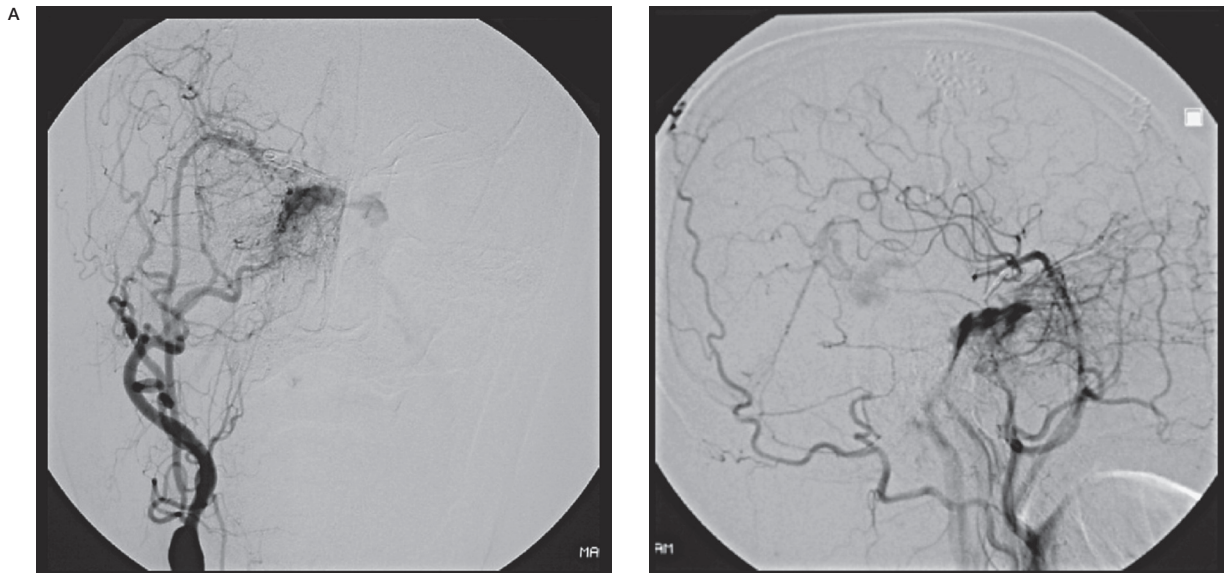

Figure 3 Right common carotid artery angiogram after internal carotid artery trapping: A-P view (A) and lateral view (B). An indirect CCF fed by multiple branches of the right external carotid artery was observed.

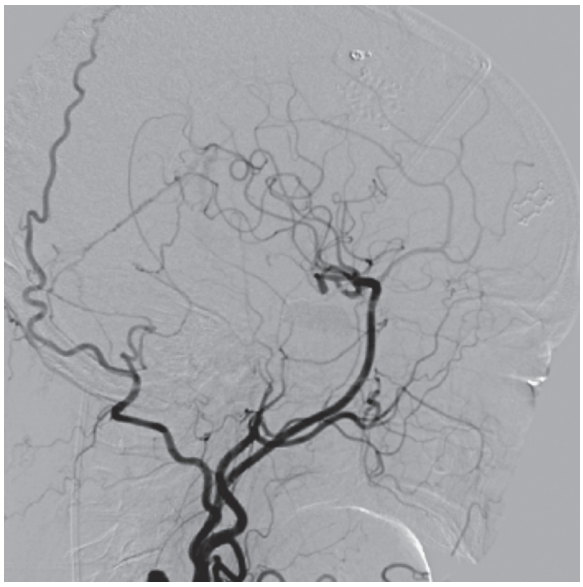

Figure 4 Right common artery angiogram after transvenous embolization lateral view showed complete elimination of indirect CCF.

drained anteriorly into the right superior ophthalmic vein (SOV). The cavernous sinus was obliterated with platinum microcoils via the transfemoral transinferior petrosal sinus route. The patient's symptoms were improved after embolization.

Discussion

We described a case of indirect CCF that developed within a relatively short period after treatment of direct CCF. The angioarchitecture of this case was more like that of CS-DAVF than traumatic indirect CCF. Indirect CCF may occur following treatment of traumatic CCF in cases in which the cavernous sinus was not occluded.

There have been some previous reports regarding traumatic indirect CCF [1,2]. Traumatic indirect CCF has a number of differences in terms of etiology, nature, and angioarchitecture compared to CS-DAVF. Based on their findings in 11 cases, Luo et al. reported that traumatic indirect CCFs have a simple architecture with a single-hole fistula and high-flow arteriovenous

shunt and are fed exclusively by the meningeal artery of the external carotid artery (ECA) [1]. They also demonstrated the effectiveness of transarterial liquid adhesive embolization. Therefore, traumatic indirect CCF should be distinguished from CS-DAVF. However, the angioarchitecture in our patient was different from these previous cases, and was more similar to CS-DAVF. Therefore, the present case is important when considering the pathogenesis of CS-DAVF.

There have been two previous case reports of the development of indirect CCF after treatment for a direct CCF [3,4]; one was treated with a detachable balloon and the other was treated with a covered stent. Although the methods of treatment were different, the clinical courses were similar in all cases, including the case reported here. All patients suffered severe head injury in traffic accidents, the cavernous sinus was not occluded after the initial treatment in all cases, and all of the indirect CCFs had a complex architecture that resembled CS-DAVF. Based on these observations, they were all suggested to have similar pathogenesis.

Clinically, sinus thrombosis and venous hypertension are known to cause CS-DAVF [2,3,5]. These events are considered to trigger angiogenesis, because the involvement of angiogenic factors was demonstrated histologically in some investigations [6-10]. The present case had comorbid direct CCF and sphenoid bone fracture that indicated dural laceration.

Angiogenic factors may be expressed during healing of the lacerated cavernous sinus wall. Moreover, venous hypertension attributed to direct CCF may also initiate expression of angiogenic factors. Patients with angiogenesis induced by sinus wall laceration and venous hypertension are at increased risk of the development of CS-DAVF.

In conclusion, development of CS-DAVF can occur after treatment of direct CCF. Careful follow-up is required even in cases in which direct CCF is cured. There are two types of traumatic indirect CCF-one with a simple arteriovenous shunt and the other with a complex angioarchitecture, similar to that of CS-DAVF. The latter may have a similar pathogenesis to CS-DAVF.

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Hideyuki Ishihara, MD
Department of Neurosurgery
Yamaguchi University School of Medicine
1-1-1 Minamikogushi, Ub
Yamaguchi, 755-8505, Japan
Tel.: +81-836-22-2295
Fax: +81-836-22-2294
E-mail: hishi@yamaguchi-u.ac.jp